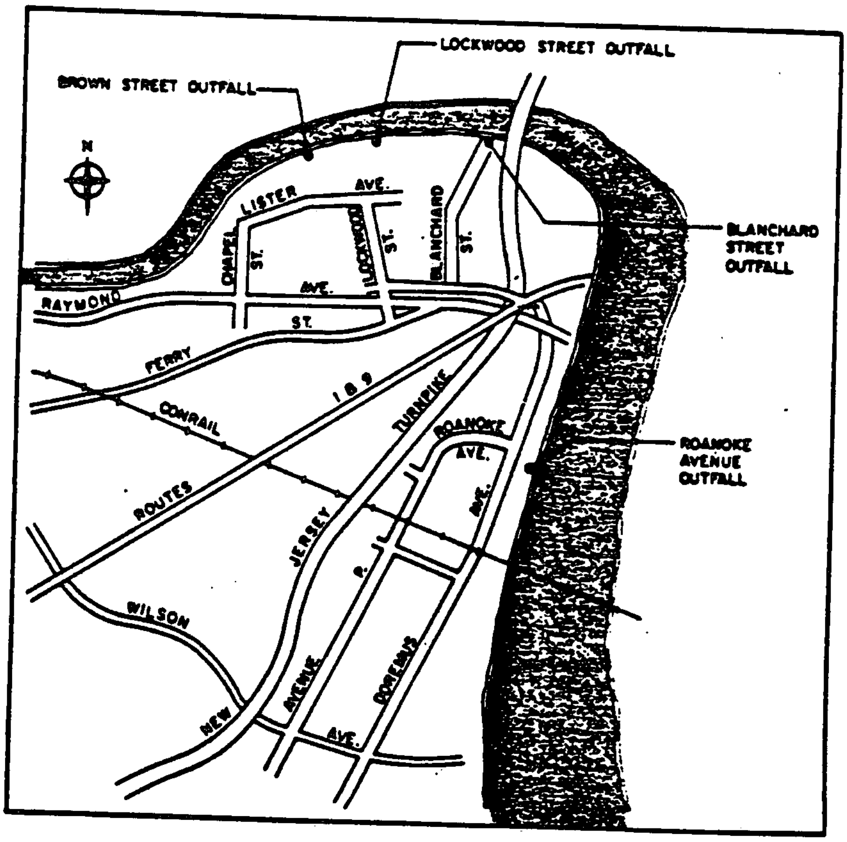
City of Newark, New Jersey

Feasibility Study

POLLUTION ABATEMENT PROGRAM



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I. Introduction

Polluted liquid wastes are being discharged into the lower Passaic River from four sewers owned by the City of Newark. These wastes include continuous discharges from the wet weather outfall of the Roanoke Avenue combined sewer, and the Blanchard Street and the Lockwood Street storm sewers, and intermittent discharges from the Brown Street sewer. During dry weather, no flow should be discharged from the Roanoke Avenue outfall and only non-polluted water from the Blanchard Street, Lockwood Street, and Brown Street storm sewers, however, high levels of pollutants have been detected in the dry weather discharges at all four locations. The following ranges of pollutant concentrations and pH have been reported by the Passaic Valley Sewerage Commissioners (PVSC) during the last two-years.

	Pollutant Concentration (ppm)			
Location	TSS	COD	BOD	pH
Roanoke Avenue	5-1428	116-15600	102-6300	2.0-7.3
Blanchard Street	5-1070	51-2815	7-420	1.9-8.2
Lockwood Street	16-3148	119-3408	8-840	3.3-9.2
Brown Street	7-93	42-352	16-135	6.2-9.8

A non-functioning regulator causes the dry weather discharge at Roanoke Avenue. Illegal connections, surface chemical spillage and contaminated groundwater are the sources of pollutants detected in the three storm sewers.

Water from the Passaic River may enter all four sewers with the incoming tide and dilute the pollutant concentration. The pollutants may also be carried upstream of their entering points. Polluted flow from the sewer increases in rate with the falling tide. The highest pollutant concentration and flow rates can be expected at low tide. During this study, samples were obtained within the three storm sewers systems at or near the times of low tide. The analytical test results of these samples are included in Appendix A.

II. SCOPE OF WORK

The PVSC industrial waste surveys for each industry in the tributary area have been reviewed and the probable pollutants in each industrial waste compared with those found in the sewer discharges. All manholes, regulators, tide gates, and inlets have been inspected. The condition and serviceability of sewerage facilities was noted. Connections to manholes and inlets and other sources of flow were located. Spillage and housekeeping procedures at the various industrial facilities were observed. Dry weather flow sampling points were selected, and dry weather flow sampled to isolate sources of pollution entering the storm sewer systems. Where possible, storm and sanitary sewers were smoke tested to locate cross connections, and the sections of storm sewer suspected of having industrial waste connections were inspected with closed circuit television. In some reaches, television inspection was not possible because of physical blockages or waste pools resulting from irregular sewer grades. The condition of the various pipes was determined and the location of improper or suspicious connections noted. The results of these investigations were analyzed and are presented in this report. Recommendations for eliminating all the sources of pollution identified by the described techniques are included.

III. Roanoke, Doremus and Wilson Avenue Sewers

A. Existing Sewers

The present sewer layout is shown on Plate 1. The manholes on Wilson Avenue are numbered consecutively from W-1 in the Avenue "P" intersection to W-9 on the westerly side of Doremus Avenue. The manholes on Doremus Avenue are numbered consecutively from D-1 on the northerly side of Wilson Avenue to D-28 on the southerly side of the Roanoke Avenue regulator. Changes made in 1951 to accommodate construction of the New Jersey Turnpike included construction of the Avenue "P" regulator on the 54-inch Roanoke Avenue combined sewer at a point approximately 1425 feet upstream of Doremus Avenue. The regulator was planned to divert all dry weather flow to the Doremus Avenue interceptor through a new 24-inch sanitary sewer paralleling the 54-inch Roanoke Avenue combined sewer. The combined sewer downstream of the Avenue "P" regulator was converted to a wet weather outfall. The 18-inch sanitary sewer in the northern portion of Doremus Avenue was connected to the new 24-inch sanitary sewer by an inverted siphon passing under the 54-inch Roanoke combined sewer and its flow bypasses the old Roanoke Avenue regulator which was sealed off and abandoned. Sewage in the Doremus Avenue sewer flows to the Wilson Avenue interceptor and discharges to the PVSC interceptor. All excess wet weather flow in the Roanoke Avenue combined sewer was intended to overflow the Avenue "P" regulator weir and discharge to the Passaic River.

B. Physical Inspection Findings

(1) Avenue "P" Regulator and Roanoke Outfall Sewer

The Avenue "P" regulator is not functioning. Over two feet of dry, granular sediment blocks the regulator gate chamber and prevents flow between the diversion chamber and the Roanoke Avenue dry weather sewer. As a result, all flow in the Roanoke Avenue combined sewer enters the Passaic River through the Roanoke Avenue outfall. There is no visible evidence of chemical attack or deterioration of the concrete regulator structure. The regulator mechanism is corroded and not functional. A wooden overflow weir, provided in the diversion chamber, is intact. This weir does not cause the upstream pipe to surcharge above the crown in dry weather. It does reduce upstream flow velocity and causes sedimentation. About 0.5 feet of primarily granular sediment was found in the combined sewer above the regulator. This material accumulates in dry weather and the lighter fractions, probably including most organic pollutants, may be flushed toward the Passaic River during relatively small rainfall events. Tests of wet weather flows in other areas indicate the flushing of such solids is accompanied by a large increase in BOD. High tides cause backup, reduce velocities, and cause sediment accumulation in the Roanoke Avenue outfall during dry weather. Some of this material may be carried away by the flow at low tide and some is scoured out by wet weather flows. About 0.2 feet of primarily granular sediment was found in the outfall sewer downstream of the Avenue "P" regulator. The size of this sewer changes to 60-inch at a manhole on the easterly side of Doremus Avenue. Remnants of the brick dam, used to divert flow into the Roanoke Avenue regulator, were observed in this manhole. There are two tide gate chambers in the 60-inch outfall. Both tide gates can swing open but neither can close completely because of sediment. No deterioration of the concrete was visible in the tide gate chambers. A lump of bituminous material is partially blocking the discharge of the 60-inch outfall.

(2) Roanoke Avenue Sanitary Sewer

The 24-inch Roanoke Avenue sanitary sewer does not receive any flow at its upstream end because of the previously described blockage in the Avenue "P" regulator gate chamber. The manhole in the 24-inch sanitary sewer immediately downstream of the regulator contains over two feet of dry sediment. The sewer receives flow from the Pitt Consol Chemical Company downstream of that manhole. About 0.5 feet of a black, tar-like sediment was found in the sewer downstream of the Pitt Consol connections. The same black material was observed on the ground surface at the Pitt Consol plant. This material was not evident upstream of the Avenue "P" regulator or in the Roanoke Avenue outfall. Its source is evidently Pitt Consol. Sampling and analysis done jointly by the PVSC laboratory and Pitt Consol also detected chemicals used at the plant in the Roanoke Avenue outfall. However, no connections from Pitt Consol were found in the outfall. Spillage appears to have contaminated the groundwater and some appears to be leaking into the outfall. Groundwater pollution may also be leaking directly into Newark Bay. Groundwater pollution was not investigated since it was outside the scope of this study.

(3) Doremus Avenue Interceptor

The Doremus Avenue interceptor receives flow from the Roanoke Avenue sanitary sewer. Severe sedimentation was noted in this line. The first four lengths of 24-inch pipe upstream from Wilson Avenue (D-1 to D-5) were constructed on a reverse grade and the fifth length (D-5 to D-6) laid flat. The invert at Wilson Avenue is 1.2 feet higher than the low point where the minimum flow depth is greater than half pipe. Further upstream the sewer size changes from 24-inch to 22-inch and then to 20-inch in diameter. Sediment depth in the

22-inch and 20-inch pipe sections varies with gradient. There is no sediment in the manhole inverts of the steeper sections of 22-inch pipe. As the gradient decreases upstream, sediment depth in the 22-inch line increases to about 0.5 feet. Sediment accumulations in the 20-inch sewer vary from 0.5 feet to 1.4 feet near the Roanoke Avenue regulator. The sediment found in the interceptor is the same black tar-like substance observed in the Roanoke Avenue sanitary sewer. The cover is missing from the fifth manhole (D-5) upstream from Wilson Avenue.

(4) Wilson Avenue Interceptor

Several of the Wilson Avenue interceptor manholes have been covered by construction activities at the PVSC treatment plant. Those manholes that were inspected had clean inverts and were flowing freely. No backup into the Doremus Avenue interceptor was observed. Most of the flow in the Wilson Avenue interceptor is pumped from the Port Newark Area.

(5) Roanoke Avenue Regulator

The Roanoke Avenue regulator was abandoned in 1951. Several feet of dry sediment has accumulated in the regulator chamber. The regulator mechanism is corroded and not functional. The regulator structure appears to be sound. There is no evidence of chemical attack or concrete deterioration. The inlet and outlet pipes are sealed.

C. Hydraulic Analysis

(1) Flow Measurement Methods

Electronic flow meters were used to obtain diurnal flow patterns in the Roanoke Avenue combined sewer, the Doremus Avenue interceptor and the Wilson Avenue interceptor. These meters were installed at the locations shown on Plate 1. The inverts of the manholes used for monitoring were free of sediment. There was tidal interference at the Roanoke outfall sewer monitoring point during each high tide. No backwater or other flow interference was apparent at the monitoring points on Doremus and Wilson Avenue. The continuous depth readings on the meter charts were converted to flow rates by use of the Manning equation. Dye dilution techniques were not used to measure flow because of the fluorescence present in the waste and the possible deterioration of the dye in the extremely acidic flow. The sewer gradients at the monitoring points were field verified. A friction factor (n) of 0.015 was used in this analysis. The actual friction factors in these sewers may be higher because of joint misalignments and sediment depositions. Flow rate is inversely proportional to friction factor. If the actual friction factor is higher than 0.015, the actual flow rates in the sewers metered will be lower than those computed and the hydraulic capacities of the existing sewers will be lower by the same proportion.

(2) Observed Flow Rates

The flow rates determined in the Roanoke outfall sewer during the period April 24, 1978 to May 30, 1978 are shown on Plates 3 & 4. These rates have been corrected to eliminate tidal effects. Minimum flow rates were found about noon with higher rates in the morning and afternoon. The flow meter data was supplemented by instantaneous measurements obtained before, during, and after the meters were installed. Maximum peak dry weather flow rates of 2.2 mgd and minimum flow rates of 0.2 mgd were recorded. The apparent constant flow rate over the weekend (April 29 and April 30) cannot be explained. The flow meter was checked on Thursday April 27 and found to be operational. On Monday, May 1, the battery and chart were changed and the calibration was checked. No errors in calibration or timing were noted and that meter remained in service during the next week. Similar uniform and high discharges occurred at other unusual times for shorter periods. Most of the flow in this sewer is discharged by two companies, Arkansas Chemical and Sun Chemical. Unusual flow patterns may result from variations in processes and work shifts at these plants.

Plates 5 and 6 show diurnal flow patterns recorded in the Doremus Avenue interceptor during the period May 1 to May 5. The flow meter malfunctioned on May 6 and no readings were obtained over the weekend. Weekend data for April 22 and April 23 was included to show the effect of antecedent rainfall and springtides on the flow rate in the sewer. The flow on April 22 was about double that of the preceding dry days. The consistency with which higher flow rates coincide with higher tide periods indicates probable inflow caused by tide related fluctuations. About two inches of rain fell on April 19, saturating the ground and raising the river level. At 8:15 PM on April 22, the tide crested one foot above normal and flow in the sewer increased from below 0.8 mgd to 1.1 mgd. Weekday flow rates generally fluctuate between 0.3 and 0.4 mgd with peaks of 0.5 mgd occurring at the times of high tide. The lowest flow rate measured was approximately 0.2 mgd.

Flow in the Wilson Avenue interceptor is pumped from the combined sewer system in the Port Newark area and discharges by gravity from the Doremus Avenue interceptor. The diurnal flow patterns recorded between May 23 and May 29 are shown on Plates 7 and 8. Rainfall during May was quite heavy, totaling almost 8 inches at

Newark Airport, or more than 4 inches above normal. However, the rainfall pattern was interesting when correlated with the measured flows. About 1.2 inches of rain fell starting May 4 and extending through May 9; 1.75 inches on May 14 followed by 1.36 inches from May 15 through May 18. On May 24, 2.58 inches of rain fell of which 2.27 inches fell prior to 4 p.m., and on May 25, 0.15 inches fell, mostly in the pre-noon hours. Hence, the measured flow rates on May 23 were preceded by four essentially dry days, while the sharp drop in rates on May 26 occurred less than 12 hours after a major storm. The measured flows of May 23 appear to more nearly represent normal flows while those of May 26 through May 29 reflect the low flows which should be anticipated during a major holiday (Memorial Day) weekend. These flows may largely reflect inflow/infiltration. Tidal variation also appears to influence inflow to this sewer. The effect of rainfall is evident in the measured data on May 24, when the Wilson Avenue interceptor was surcharged. The flow-full capacity of the interceptor at the monitoring point has been estimated as equal to 6.2 mgd. Hence, the flow was greater than that amount. The PVSC interceptor was not continuously monitored but no dry weather backups into Wilson Avenue were observed during spot inspections.

(3) Diversion of Roanoke Flow to PVSC Interceptor

The feasibility of diverting dry weather flow from the Roanoke Avenue combined sewer, as intended, through the Doremus and Wilson Avenue interceptors and into PVSC interceptor was analyzed. It was assumed that the appropriate regulator would be restored to service and that the downstream sewers could be cleaned. The limited metering indicated the peak dry weather flow rates in each sewer could be concurrent. The peak flows in the 20-inch sewer on Doremus Avenue were obtained by instantaneous measurements. The dry weather peak flows (excluding the May 26 flows) recorded are shown here-following:

Location	Sewer Diameter in Inches	Peak Dry Weather Flow Rate in mgd
Wilson Avenue Interceptor	24	6.2(1)
Doremus Avenue Interceptor	22 & 24	1.1
Doremus Avenue Interceptor	20	0.5
Roanoke Avenue Outfall Sewer	54	2.2

(1) Full Pipe - no surcharge

As indicated by the measured flows between 10 and 11 p.m. of May 25, higher peak dry weather flows in the Wilson Avenue interceptor than those of May 23 may be probable. With a field verified sewer gradient between manholes W-9 and W-8 of 0.0025 ft/ft the flow-full capacity of the Wilson interceptor closely approximates 6.2 mgd. The peak capacity of 4.5 mgd, cited in the PVSC Infiltration/Inflow Analysis, was computed for a monitoring point approximately 1500 feet downstream of manhole W-8. This sewer is now being resurveyed by E.T. Killam Associates to verify both the estimated capacity and amount of I/I.

If the Roanoke Avenue flow was redirected, peak flow rates at least as great as those shown below could occur. These flow rates would exceed the capacity of the Doremus and Wilson Avenue interceptors and cause surcharging in both lines. The hydraulic gradients required to force these flows through the sewers, and the resulting flow velocities are also shown below.

Interceptor Location	Sewer Size in Inches	Peak Dry Weather Flow Rate in mgd	Grade Line ft/ft	Flow Velocity in fps
Wilson Avenue	24	8.4+	0.0046	4.3
Doremus Avenue	24	3.3	0.00075	1.7
Doremus Avenue	22	3.3	0.0011	1.9
Doremus Avenue	20	2.7	0.0012	1.9

Surcharging to the levels indicated below would be required to pass these flows through the system.

Manhole Number	Height in Feet of Surcharge Above Crown of Pipe	Height in Feet of High Tide Above Flow Surface
W-9	3.6	6.5
D-6	5.8	5.3
D-21	3.2	2.0
D-28	2.1	0.4

It would accordingly be possible to restrict activation of overflow devices to elevations equal to or slightly above the high tide. Due to the proximity of the Passaic River, industrial buildings in the area are located several feet above the high tide elevation. All of the building sewers observed in the manholes on Wilson and Doremus Avenues had drop connections. Buildup of sediment is not anticipated in the building sewers because none of the connections inspected were below the computed levels of surcharge. The height of surcharge is nominal and no damage is anticipated as a result of increased internal pressures. Infiltration rates would be reduced as internal pressures increase.

The current cause of bypassing at Roanoke Avenue is the faulty Avenue "P" regulator. However, upon repair of the Avenue"P" regulator, extraneous flows could occasionally overload the restored downstream sewers sufficiently to cause a backup and subsequent overflow at time of peak dry weather flow. The flows in the Roanoke Avenue combined sewers could be transported to the PVSC treatment plant during off-peak hours without reducing the present infiltration rates. This would require storage regulation in existing sewers and could be justified as a pollution abatement measure. Infiltration rates in the Roanoke Avenue combined sewer do not appear to be high. Low flow rates of 0.2 mgd have been recorded. The low flow rate in the Doremus Avenue interceptor was also less than 0.2 mgd. Infiltration in these sewers can not be greater than the low flow rates. Increased flow rates, apparently indicating additional inflow, were recorded during the times of high tide. In the Wilson Avenue interceptor, a low flow rate of 2.1 mgd was recorded. Much of that flow was pumped from the Port Newark area and may largely represent infiltration. Infiltration in the Roanoke Avenue and Doremus Avenue sewers was not investigated in greater detail because of its small magnitude. Investigation of the Wilson Avenue interceptor and the Port Newark area was not within the scope of this study. All of the sewers discussed are included in the PVSC's Infiltration/Inflow Analysis and have been recommended for a sewer system evaluation survey. Any infiltration reduction resulting from this study would reduce the anticipated surcharging in the Wilson and Doremus Avenue interceptors but, it is unlikely that the reduction would be sufficient to prevent all dry weather flow discharges at Roanoke Avenue after flow diversion to the Doremus Avenue Interceptor.

(4) Diversion Works

Prior to redirecting the Roanoke Avenue flow, the downstream sanitary sewers should be cleaned and either the Avenue "P" or the Roanoke Avenue regulator should be restored to service. It appears preferable to restore the Roanoke Avenue regulator for several reasons. By constructing a collapsible dam or other appropriate water level control device downstream of the regulator, an additional 1450 linear feet of 54-inch pipe would be available to store wet weather and peak dry weather flows for later diversion and treatment. In addition, the apparently contaminated groundwater leaking into the pipe at the Pitt Consol plant would be diverted to treatment, and the 24-inch Roanoke Avenue sanitary sewer would not require cleaning.

The Doremus and Wilson Avenue interceptors are over fifty years old, and the preceding analysis assumes these sewers are structurally sound and can be cleaned. This may be incorrect and the existing sediment in these lines could preclude redirecting the Roanoke Avenue flow, but require the construction of new sewers. A four step program is recommended for placing the system back in full service.

(1) Four lengths of the Doremus Avenue interceptor and one length of the Wilson Avenue interceptor should be cleaned and televised. About 1000 feet of sewer would be inspected at an approximate cost of $6,000. The following pipe sections, designated by the manhole numbers previously described, might be inspected: D-27 to D-28 (20-inch), D-16 to D-17 (22-inch), D-9 to D-10 (22-inch), D-3 to D-4 (24-inch), and W-5 to W-6 (24-inch).

(2) If the lines initially inspected are structurally adequate and in good alignment, the remaining footage may be cleaned and televised. If the Doremus Avenue interceptor requires

cleaning, it is estimated that 3000 linear feet of sewer would require bucket machine cleaning and 1600 linear feet, hydraulic tool cleaning. No sedimentation was observed in the Wilson Avenue interceptor and no cleaning appears required. The additional cleaning and televising in the second step would cost approximately $38,000.

(3) If the sewers are in acceptable condition, the Roanoke Avenue regulator would be restored to service. The structure would be cleaned, new regulator components installed and plugs removed from the pipes connecting to the regulator. This work would cost approximately $10,000.

(4) A flow regulating structure would be constructed downstream of the regulator at a cost of about $100,000. The cost of the complete restoration program is summarized below:

Initial Cleaning and Inspection	$ 6,000
Complete Cleaning and Inspection	38,000
Regulator Repairs	10,000
Flow Regulation Structure	100,000
Total Cost	$154,000

In addition to providing relief from all dry weather overflows from the Roanoke sewer, this program would also divert to treatment combined sewage which would otherwise discharge untreated during the most frequent rainfalls. If the existing sewers can not be cleaned, new sewer construction would be required to eliminate the bypassing at Roanoke Avenue.

If the dry weather flow in the Roanoke Avenue combined sewer is diverted, the Doremus and Wilson Avenue interceptors will operate in a surcharged condition. Peak flow velocities in the Doremus Avenue interceptor will be below 2.0 feet per second, and velocities at nonpeak times, lower. Sedimentation should be anticipated in the Doremus Avenue interceptor. This sewer should be inspected on a regular basis to monitor sediment build up. Cleaning on a regular basis may be desirable. Pollutants may be cleaned effectively by low volume water flushing. Heavier sediment would probably require hydraulic tools.

D. Conclusions and Recommendations

1. If structurally sound and in good alignment, the existing Doremus and Wilson Avenue interceptors should be cleaned and used to transport most dry weather flow in the Roanoke Avenue combined sewer to the PVSC treatment plant. However, relatively rare dry weather overflows may still occur. These may be eliminated by installing a flow routing device in the Roanoke outfall sewer, downstream of Doremus Avenue. The restoration program discussed previously should be implemented. The total cost of cleaning, internal inspections and regulator restoration work should be approximately $54,000. The flow routing device might cost about $100,000. Sedimentation in the Roanoke and Doremus Avenue sewers should be monitored and cleaning operations performed as necessary. This program is recommended as an immediate and temporary solution. It is estimated that the proposed restoration work could be completed within six months. The flow routing device installation should require about eight months for completion.

2. The flow routing device may be part of a long term solution for combined sewer overflow pollution abatement which should be developed in future studies.

3. Reconstruction or paralleling of the existing interceptors will be necessary if their structural condition or alignment precludes redirecting the Roanoke Avenue combined sewer flow. When new sewers are planned, the storage and routing of wet weather combined sewer flow must be considered along with future industrial expansion and sewer system evaluation survey recommendations. Sizing replacement interceptors is not possible with the information

presently available. For estimating purposes, it was assumed that a 24-inch sewer would be required on Doremus Avenue and a 30-inch line on Wilson Avenue. The depth of these sewers, high groundwater levels and poor foundation conditions will increase construction costs. The proximity of railroad spurs and gas transmission lines to Doremus Avenue will further increase costs. An approximate 1978 construction cost estimate follows.

	Pipe Diameter in Inches	Length of Sewer in Feet	1978 Construction Cost Estimate
Doremus Avenue	24	5400	1,080,000
Wilson Avenue	30	1700	510,000
	Contingencies		410,000
	Total Construction Cost		$2,000,000

Alternatives to the complete reconstruction of both interceptors may be developed when more information is available. For example, the reconstruction of the Doremus Avenue interceptor may be combined with significant infiltration/inflow reduction in the Port Newark Area, thereby allowing the existing Wilson Avenue interceptor to remain in service. Additional studies will be required before the feasible alternatives can be defined and the most cost effective long term solution selected.

4. Industrial pretreatment regulations should be enforced in the tributary area. The low pH of the Roanoke effluent is a threat to the structural integrity of both sewers and accessories. The corrosive atmosphere in this sewer attacked electrical connections on the flow meter and caused several malfunctions. The condition of the pipes is not

known. It is probable that some deterioration has occurred even though it was not observed in the structures. Area industries should also be requested to review their internal operating procedures and reduce peak discharge rates to the extent possible.

5. Possible groundwater contamination at the Pitt Consol plant should be investigated. The firm should be required to control chemical spillage and, to the extent feasible, clean up spills that have already occurred. The black tar-like material found in the sanitary sewers evidently originates at the Pitt Consol plant. The discharge of this material should be prohibited.

6. The tide gate chambers in the Roanoke Avenue outfall should be cleaned and the gates serviced. The lump of bituminous material should be removed from the discharge point.

IV. Blanchard Street

A. Physical Inspection Findings

Blanchard Street is served by separate storm and sanitary sewers. The 24-inch storm sewer (see Plate 2), constructed in 1917, discharges to the Passaic River. In 1970, the storm sewer was extended and the sanitary sewer was rebuilt. The sanitary sewer connects to a trunk sewer in Raymond Boulevard. The sanitary sewer is clogged by grease, tallow, paper and black oily waste. Several sanitary manholes were observed to surcharge and overflow into the street. These overflows usually occurred between 11:00 a.m. and 3:00 p.m. on weekdays. The frequency of overflow varies depending on industrial discharge rates. It does not appear to be related to rainfall events. Overflows were observed at least once a week and were noted on ten consecutive weekdays in April 1978. Intermittent overflows may have occurred during the last few years. These sanitary overflows are a major source of pollutants in the Blanchard Street storm sewer. City forces had been cleaning the Blanchard Street sanitary sewer when backups and overflows were reported. Equipment breakdowns and manpower shortages caused a suspension of cleaning operations in 1978.

Prior to cleaning, the storm sewer contained between 1.0 and 1.5 feet of primarily granular sediment mixed with black oil. The oil, which comes from the overflowing sanitary sewer, coats the inside of the pipes and manholes. Several inlets were filled with debris and sediment. The tide gate is mounted on a headwall on the river bank. The gate was being held open by sediment and debris during the first field inspection. The gate appeared to be fully operational after City personnel removed the sediment in April 1978. In subsequent inspections floating debris had lodged again under the gate indicating the need for frequent maintenance. A continuous waste discharge was noted. Dry weather flow rates, varying between 10,000 gpd and 100,000 gpd were estimated using depth measurements. The source of this flow appears to be groundwater. Dry weather flow was observed above manhole B-7 only when the sanitary sewer was overflowing or the drainage ditches along the Conrail industrial spurs were flooded.

Inlets B-106, B-107, B-108, B-109, B-110 and B-111 receive flow from the railroad spurs and sidings. The ditches along these tracks drain wet lands which were observed to contribute continuous flow for up to two weeks during wet periods. Chemical spillage was observed on the tracks and in the adjacent ditches. The source of the chemicals appears to be leakage from railroad tank cars. No leaking cars were observed, however. Major spills were noted from the Atlas Refinery Inc. railroad siding. Rain washes some of this spillage through the drainage ditches and railroad ballast into the Blanchard Street storm inlets. Since no leaking cars were found on the Conrail spurs, it is not possible to link other specific industries to the spillage. Valves may not always be closed when the cars are unloaded and chemicals may drip out while the cars are standing on the spurs in a totally random pattern. The Fairmount Chemical Company, the Benjamin Moore Company, Atlas Refinery Inc, and the Fiske Brothers Refining Company all receive tank cars through this railroad spur.

Four pipes were observed along the railroad tracks west of Blanchard Street. Two of the pipes drain the Delissa Pallet storage area and are not sources of pollution. The other two are filled with earth and appear to be old railroad culverts. Railroad drainage ditches are connected to inlets B-106 and B-108 by pipes. The pipe at B-108 is clogged with earth; this causes partial flooding of the siding during rainfall events. Leaks were found in the walls and under the frames of inlet B-106 and B-107 when the ground was saturated. The sanitary sewer is adjacent to inlet B-107 at an elevation lower than the leaks observed. The inlet was inspected in dry weather when the sanitary sewer was surcharged and no leakage was observed. During another inspection made during a rainfall event, the sanitary sewer was not surcharged but the inlets walls were leaking, implying that the leakage in inlet B-107 is not caused by sanitary sewer exfiltration. Inlet B-106 is on the opposite side of the street and has the same type of leakage, implying that the leakage is groundwater.

Two minor sources of flow were observed. Neither is believed to be a significant source of pollution. Newark Boxboard Company discharges a small volume of cooling water into the gutter adjacent to their loading dock area. A sump pump at Fairmont Chemical Company intermittently discharges groundwater into the gutter near manhole B-6. The City of Newark is aware of this discharge and had previously inspected the facility. No discharging was observed during the field inspections but water was noted along the curb. The water was clear and there was no evidence of chemical contamination. Algal growth was noted in the water along the curb.

B. Dry Weather Sampling and Flow Rates.

Samples were obtained at the following locations:

B-2 300 feet south of the Passic River

B-6 1100 feet south of the Passic River

B-7 1300 feet south of the Passaic River

Samples were obtained at B-2 and B-6 on May 2, 1978 and at B-2, B-6 and B-7 on June 14, 1978. The May samples were taken two hours before low tide with tide water in B-2. The June samples were obtained at low tide while the Passaic River level was below the invert of the discharge pipe. Appendix A shows the results of laboratory analysis of the samples. The May samples show higher levels of pollution at B-6 than at B-2 downstream. This difference can be attributed to dilution of the pollutants by tide water at B-2. (note chloride concentrations) There was no tidal flow in the line when the June samples were taken. The pollutant concentrations at B-6 and B-7 were similar. There was a substantial increase in pollutants at B-2. This increase may result from leaching from abandoned septic tanks in the area. The sanitary sewer was not overflowing and the storm sewer was not receiving flow from the railroad drainage ditches when the samples were obtained. The flow rate during both sampling operations was estimated at 50,000 gpd.

C. Smoke Testing

Smoke testing of the entire storm and sanitary sewer system was planned. However, the sanitary sewer was surcharged and badly clogged with grease so that smoke could not be pumped through it. The sanitary sewer could not be dye tested to observe exfiltration due to the oil and hardened grease sealing the manholes above the top of the pipe. The entire storm sewer was smoke tested at low tide. Smoke did not pass between manholes and was observed only at inlets connected to points where smoke was blown in. It appeared that there were blockages or severe misalignments in the storm sewer. No smoke entered industrial facilities and no smoke was observed at roof drains. The absence of smoke in adjacent buildings does not preclude the existance of illegal connections with water traps.

D. Television Inspection

Illegal connections were suspected downstream of manhole B-7. Television inspection was planned for 1250 feet of 24-inch storm sewer between manholes B-1 and B-7. The line required cleaning with bucket machines prior to the television inspection. The bucket machine operation encountered obstructions in the pipe which caused the buckets to become lodged frequently. In no single section could a 24-inch tool be passed. Openings varying between 12-inch and 18-inch were cleared. Most of the sediment was removed, but pieces of the 24-inch pipe were also brought out in the buckets which caused suspension of this operation. The obstructions encountered could be the result of joint misalignments, partial cave-ins and pipe fragments lodged in the line. Further cleaning operations could have caused collapse of the street.

Television inspection was attempted without further cleaning. Several attempts were made to pull the camera through various portions of the line. In every case but one, the camera went under water within 10 feet of the manhole and the skids lodged on obstructions. The first 45 feet of line downstream of manhole B-2 were visible. The pipe was cracked and a partial collapse was observed approximately 45 feet downstream of the manhole. Pieces of pipe had fallen into the line and the camera could not pass over them. An 8-inch connection was found in manhole B-5 below the sediment level during the cleaning operations. This connection was filled with sediment and was inactive. The problems encountered during cleaning and television inspections operations are described in greater detail in Appendix B. The 24-inch storm sewer is not structurally sound. This sewer was constructed in 1917 and has been subjected to very heavy truck traffic for the last several decades. A partial collapse of the street could occur as this pipe continues to deteriorate.

E. Conclusions and Recommendations

1. The frequent overflow of sanitary sewage may be considered the most serious source of pollutants found in the storm sewer. The 2500 linear feet of sanitary sewer should be cleaned to prevent future surcharging and overflows. Contracting this work would cost approximately $10,000. Area industries should be required to conform to discharge quality standards and cease discharging grease, tallow, paper and oil into the sanitary sewer. After cleaning, the sanitary sewer should be dye tested to determine if sewage is exfiltrating into the storm drainage system.

2. Industries that receive and ship chemicals in railroad tank cards should be required to control spillage and leakage. All tank car valves should be closed prior to moving the unloaded cars back onto the Conrail spurs. Atlas Refinery should be required to clean up the spillage at its siding and prevent future spills.

3. The 24-inch storm sewer, downstream of manhole B-7, should be replaced. The problems encountered during the cleaning and television work indicate that the sewer is cracked, misaligned, and partially collapsed in places. Sizing a new sewer is beyond the scope of this study, however, a 30-inch replacement was assumed for estimating purposes. The 1978 construction cost of 1300 linear feet of 30-inch storm sewer, manholes, tide gate chamber, and headwall would be approximately $450,000. Replacing this sewer will prevent the collapse of the roadway, locate any illegal connections, and eliminate the infiltration of contaminated groundwater.

4. The existance of illegal connections could not be verified because the condition of the storm sewer prevented internal inspection. Illegal connections may exist downstream of manhole B-7. However, because of the age and condition of the 24-inch storm sewer, its proximity to abandoned septic fields and high groundwater in the area, contaminated groundwater is also a probable source of pollutants in the storm sewer. Pollutants may also be leaching directly into the river. Further studies should be made of groundwater pollution in the entire study area.

5. The Fairmount Chemical Company should be required to redirect its sump pump discharge into an inlet.

6. The connection found in manhole B-5 should be sealed.

V. Lockwood Street Outfall

A. Physical Inspection Findings

The storm sewers in Lockwood Street, Lister Avenue, Chapel Street, Albert Avenue, Euclid Avenue and the Morris Canal Right-of-Way all drain through the Lockwood Street outfall (see Plate 2). Drainage from parts of Raymond Boulevard, Ferry Street, and the Pulaski Skyway ramp are also connected to the Lockwood Street system. Separate sanitary sewers serve the entire area. All storm manholes and inlets in the study area were inspected. The limits of tidal flow were identified and all sources of dry weather flow were isolated. Chemical spills at industrial facilities were noted. The Morris Canal storm sewer west of Lockwood Street (LW-8 to MC-11) was lamped.

(1) <u>Lister Avenue Sewer</u>

The manholes, inlets and pipes on Lister Avenue were coated with a black oily material. Sediment depth varied between 0.5 and 1.5 feet. The source of the oil was spillage at the B-Line Trucking Company. Tank trucks are allowed to drain while parked at this facility. Black oily chemicals flow into inlets on Lister Avenue and Esther Street. The flow into Esther Street is continuous and the curb has been broken out to facilitate it.

A continuous flow of viscous orange chemicals was observed entering an inlet on Cornelia Street. This material came from leaking drums stored on the Cellomer Corporation property. These chemicals were entering the Lister Avenue storm sewer. Intermittent spillage of black oily chemicals was noted at the Fiske Brothers Refining Company railroad siding and a very small volume of water and oil from that industry was being discharged into Esther Street. Both flows were entering the Lister Avenue storm sewer. A cooling water discharge pipe from Fiske Borthers was found at the inlet on the southwest corner of Lockwood Street and Lister Avenue. A 2-inch ± connection was found entering inlet LS-10. Because of its diameter, it is improbable that this line contains wastes. It was not flowing when inspected. The only building near LS-10 is occupied by the State Produce Company. No dry weather flow was observed upstream of manhole LS-12 and no sources of pollution are suspected above that point.

(2) <u>Morris Canal Sewers</u>

Continuous flow was observed in the Morris Canal storm sewers east and west of Lockwood Street. The flow in the easterly line (LW-8 to MC-105) was traced to the Newark Boxboard Company. This flow was estimated at 0.16 mgd using depth measurements. The municipal swimming pool on Waydell Street was discharging an estimated 0.07 mgd into the westerly line upstream of manhole MC3. The car wash drains at the Sunoco Station on Raymond Boulevard were found to be connected to the storm sewer between manholes MC3 and MC-4. Personnel at Associated Auto Body and Trucks Inc. were observed dumping paint into the storm sewer between manholes MC-6 and MC-7. Manhole MC-7 is the limit of tidal influence and no dry weather flow was observed upstream of that point. A partial blockage was found in the invert of manhole MC-2. Sediment varying in depth between 0.5 and 1.0 feet was noted between manholes LW-8 and MC-7.

(3) <u>Euclid Avenue Sewer</u>

The flow in the Euclid Avenue storm sewer, estimated at 0.02 mgd, was traced to the Reddaway Manufacturing Company's cooling water discharge at inlet E-104.

(4) Albert Avenue Sewer

Tidal flow was observed in the Albert Avenue storm sewer up to manhole A-3. A minor, intermittent flow of water and oil from Cellomer enters the Cornelia Street gutter and flows to the Albert Avenue storm sewer. However, no dry weather flow was actually observed upstream of manhole A-3.

(5) Lockwood Street Sewer

No dry weather flow was observed in the Lockwood Street storm sewer upstream of manhole LW-8. There is no indication of pollutant sources above that point. The cross-connections shown on the sewer plans were inspected and found to be sealed. A railroad drain on the south side of the Messinger Trucking and Warehouse Corporation building appeared to be connected to the Lockwood Street sanitary sewer. Major spillage of chemicals was observed at the Atlas Refinery Inc. railroad siding. The eastern portion of this siding drains into railroad drainage ditches that are connected to the Blanchard Street storm sewer system. The discharges from Newark Boxboard, the municipal swimming pool, and Reddaway Manufacturing produce a base discharge of approximately 0.25 mgd.

(6) Lister Avenue Tide Gate

There was no evidence of chemical attack or deterioration of the concrete chamber. Sediment in the invert of the chamber prevents the Lister Avenue tide gate from closing completely. The gate allows inflow during the rising tide. Assuming a five foot tidal range and an open tide gate, approximately 270,000 gallons of river water enters with each incoming tide, mixes with pollutants being discharged into the system and flows back into the river as the tide falls. A typical diurnal flow pattern at the tide gate is shown on Plate 9. If the tide gates were to close completely, the discharge from the system of any polluted flow would be restricted to a relatively short period around low tide.

(7) Lockwood Street Outfall

An abandoned railroad drain was found connected to manhole LS-1. The last 25 feet of the 72-inch outfall was exposed and showed evidence of chemical attack. Portion of the crown had completely deteriorated. The headwall was not deteriorated and there was no evidence of chemical attack below the spring line of the pipe.

B. Dry Weather Flow Sampling and Flow Montoring

Sources of dry weather flow and limits of tidal influence were noted during the physical survey. Those sewers in which flow was observed were subdivided for sampling. The first set of samples was obtained on May 2, 1978. The second set was taken on June 14, 1978. The laboratory analysis of these samples is shown in Appendix A. Both sets of samples show high levels of pollution on Lockwood Street, Lister Avenue, Albert Avenue, and the easterly portion of the Morris Canal storm sewer. The samples in the Euclid Avenue sewer fell within water quality standards. Because of tidal action, it was not possible to confirm that all high pollutant readings were caused by discharges near the respective sampling points. A discharge of pollutants anywhere in the system within the tidal range could be mixed and carried to distant sampling points. Samples were obtained at the following locations.

LW-0	Lockwood Street Outfall at the Passaic River
LS-2	Lister Avenue upstream of the tide gate chamber
LS-4	Lister Avenue upstream of Lockwood Street
LS-7	Lister Avenue at Joseph Street
LW-1	Lockwood Street upstream of Lister Avenue
LW-4	Lockwood Street upstream of Albert Avenue
LW-7	Lockwood Street downstream of the Morris Canal
A-1	Albert Avenue at Lockwood Street
A-3	Albert Avenue at Joseph Street
E-1	Euclid Avenue at Lockwood Street
E-104	Euclid Avenue (cooling water connection at inlet)
MC-1	Morris Canal at Lockwood Street (west side)
MC-3	Morris Canal 500 ft. west of Lockwood Street
MC-7	Morris Canal 1400 ft. west of Lockwood Street
MC-100	Morris Canal at Lockwood Street (east side)
MC-104	Morris Canal 800 ft. east of Lockwood Street

Euclid Avenue was eliminated from further study because of sampling results. The cooling water discharged at Reddaway Manufacturing was sampled at inlet E-104. The Morris Canal storm sewer west of Lockwood Street (LW-8 to MC-11) was eliminated on the basis of physical inspection, lamping and sampling. The intermittent sources of pollution at the Sunoco Car Wash and Associated Auto Body have been identified. The high levels of pollutants detected at manhole MC-1 in the May 2 sampling is attributed to these sources. Sediment downstream caused flow to pool at manhole MC-7 and remain there as the tide went out. Pollutants from downstream appear to have been carried into that manhole by the tide causing the contamination detected in the MC-7 sample on June 14. The 72-inch Lockwood Street Outfall was not televised because there was no evidence of pollutant sources in the line. The Benjamin Moore Company is the only industry adjacent to the outfall. Maps provided by the City of Newark show the roof drains from one building connected to the outfall. The Benjamin Moore laboratory is located in that building but there are no chemical process facilities. The plant engineer indicates that all other surface and roof drainage is pumped directly into the Passaic River. All other storm sewers in which flow was observed were scheduled for television inspection.

C. Smoke Testing

The storm and sanitary sewers on Lockwood Street, Lister Avenue, Albert Avenue, and the easterly portion of the Morris Canal right-of-way were smoke tested. No problems were observed when the storm sewers were tested. The pipe connecting to manhole LS-1 was found to terminate in an embankment along the nearby railroad spur. This pipe may have functioned as a railroad drain before the track elevation was lowered; it serves no purpose now. The effectiveness of the smoke testing may have been reduced in the larger storm sewers. Blowers were used to force smoke into the pipes under pressure. The volume of the Lockwood Street storm sewer (66-inch) and the number of inlet openings reduced the pressure behind the smoke and may have prevented it from reaching remote connections.

Three inflow sources were detected when the sanitary sewer was smoke tested. All observed roof and area drains at Atlas Refinery Inc. were connected to the sanitary sewer. These drains are a major source of inflow and should be reconnected to the storm sewer. A cross connection was found at the intersection of Joseph Street and Lister Avenue. The storm inlet at the southwest corner of the intersection is connected to the adjacent sanitary manhole. The sanitary sewer elevation is lower than the inlet invert. Sanitary sewage could enter the storm sewer if a blockage occurred. Smoke also escaped from the site of a demolished building at the southwest corner of the Lockwood Street-Albert Avenue intersection. It appears that the building connection was not sealed. No smoke was observed escaping from plumbing vents. It is probable that all connections to the storm and sanitary sewer have line traps which would prevent the passage of smoke.

D. Television Inspection

The following lengths of storm sewer were inspected using closed circuit television.

Lister Avenue	LS-1 to LS-3
Lister Avenue	LS-4 to LS-11
Lockwood Street	LS-3 to LW-8
Albert Avenue	A-1 to A-3
Morris Canal	LW-8 to MC-104

The inspection of the Lister Avenue line revealed an oil separator at Atlas Refinery Inc. connected to the 66-inch storm sewer approximately 120 ft. upstream of manhole LS-2. This connection is believed to be a major source of pollutants. There is a railroad siding drainage system connected to this oil separator. Tank cars containing chemicals are unloaded at the siding daily and spills are frequent. Much of the spillage is believed to pass through the separator and enter the Lister Avenue storm sewer. No other sources of flow were found during the television inspection of Lister Avenue. Significant settlement was noted between LS-4 and LS-11. The television camera went under water frequently and came out at inlets and manholes. Most lengths of pipe had settled more than 15 inches. Based upon the portions of line that could be seen and the relatively recent date of construction (1970), no illegal connections are suspected. The pollution in the line results from spillage at B-Line Trucking and Cellomer, as well as pollutants washed in by the tide. The flow from the Atlas oil separator, immediately downstream, could cause high pollutant concentrations in the Lister Avenue storm sewer.

Several connections were found in the Lockwood Street storm sewer between manholes LW-4 and LW-3. Pipes were located 34 ft., 92 ft., 104 ft., 133 ft., 143 ft. and 200 ft. downstream of manhole

LW-4. The pipes at 92 ft. and 104 ft. are shown on old plans as connections to inlets at the intersection. These inlets were connected to the new Albert Avenue storm sewer in 1970. The pipes at 34 ft., 143 ft. and 200 ft. appear to be roof or floor drain connections to the Messinger Trucking and Warehouse Corporation building. There are no wastes eminating from this facility. The connection at 143 ft. may also be a concrete spall; the pipe could not be seen clearly. The connection at 133 ft. comes from the west side of the street in the vicinity of the Albert Avenue intersection. This pipe is not shown on the storm sewer plans, but it may be an abandoned inlet connection. These connections were not flowing when the pipe was televised.

A connection of unknown origin was observed in the Lockwood Avenue storm sewer 53 ft. downstream of manhole LW-3. Inlet connections were also observed 170 ft. and 183 ft. downstream of LW-3. The pipe at 53 ft. connected on the east side and may be from Atlas Refinery Inc. A pipe crossing broken into the crown of the 66-inch line and running perpendicular to it was noted at 201 ft. These pipes were not flowing when televised. A 2-inch $\pm$ connection located approximately 10 ft. upstream of manhole LW-2 has been observed by City personnel. This connection comes from the east side of the street and was discharging flow when observed. This connection appeared to originate at Atlas Refinery Inc.

Three connections were noted between manholes LW-2 and LW-1 in the Lockwood street storm sewer. Pipes were observed 149 ft., 159 ft. and 215 ft. downstream of manhole LW-2. The connection at 159 ft. is believed to be from an inlet that was removed during construction of a new building at Atlas Refinery Inc. The connection at 149 ft. appeared to be a large pipe 24-inch $\pm$ surrounded by roots. It could also be a connection crossing the 66-inch line. The connection at 215 ft. was from the westerly side of the street. It could not be seen clearly and may be a concrete spall. No flow was observed from any of these pipes.

No improper connections were found in the Albert Avenue storm sewer or in the Morris Canal line between manholes LW-8 and MC-104. The pollutants detected in the Albert Avenue line appear to have been carried in by tidal action. Two sources of pollutants are suspected in the Morris Canal sewer east of Lockwood Street. The limit of tidal influence is downstream of manhole MC-104. Yet, pollutants were detected in the sample obtained at that manhole. Newark Boxboard discharges the flow sampled at MC-104 and that flow is polluted. However, the concentration of pollutants downstream, at manhole MC-100, is three times greater than at MC-104. Some pollutants may settle into the sediment during the high tide periods. Flow from Newark Boxboard may flush some of this material and carry it into the Lockwood Street storm sewer.

E. Conclusions and Recommendations

1. Several improvements are required at Atlas Refinery Inc. The firm should be required to connect its oil separator to the sanitary sewer rather than to the storm sewer. The spillage at the railroad siding should be cleaned up and procedures developed to prevent future spills. Roof and area drains should be connected to the storm sewer rather than to the sanitary sewer as at present. The plant has been expanded several times over the years and complete plans of the piping systems are not available. The Lockwood Street storm sewer is located under the sidewalk in front of the Atlas plant. Connections could have been made without excavation in the street. Connections of unknown origin between manholes LW-3 and LW-1 appear to lead to drains in the Atlas plant complex. Fiske Brothers Refining Company, the industry across the street, is a less likely point of origin since they would have had to excavate the street and cross the sanitary sewer to make connections to the storm sewer. Atlas should be required to evaluate its piping and identify connections to the storm sewer. Any sanitary facilities, chemical processes, or drains that accept polluted flow should be reconnected to the sanitary sewer. Authorized discharges to the storm sewer should be made through a manhole or chamber to allow monitoring by the City.

2. Fiske Brothers Refining Company should be required to cease discharging oil and water into Esther Street and to prevent spills at their railroad siding. Fiske Brothers should be required to identify existing connections to the storm sewer. Connections that accept pollutants should be reconnected to the sanitary sewer. Connections that carry

nonpolluted flow should be made through a chamber to facilitate monitoring by the City.

3. After Atlas and Fiske Brothers have evaluated their piping and reconnected lines as necessary, the remaining connections of unknown origin between LW-3 and LW-1 should be sealed as a precaution. Initially, temporary plugs should be installed. If the lines are active, a backup will be reported. If no problems occur after one month, the connections should be permanently sealed. The connections observed between LW-4 and LW-3 are believed to be roof drains from the Messinger Warehouse and abandoned inlet connections. They should not be sealed.

4. B-Line Trucking Company should be required to cease discharging black oily waste into Lister Avenue and Esther Street. The spillage that has already occurred should be cleaned up. This flow is believed to be the major source of black oil in the system.

5. Newark Boxboard Company should be required to evaluate its internal piping. Only nonpolluted flow should be discharged into the Morris Canal storm sewer. Polluted flow should be discharged into the Blanchard Street sanitary sewer after that line is cleaned. The City should monitor the flow at manhole MC-104 to assure compliance.

6. Associated Auto Body and Trucks, Inc. should be prohibited from dumping paint or other wastes into the Morris Canal storm sewer.

7. The car wash drains at the Sunoco Station should be reconnected to the sanitary sewer. Suitable grit removal and oil separation facilities should be provided.

8. Cellomer Corporation should be required to clean up the spillage on their property and cease discharging oil into Cornelia Street. It should be noted that Cellomer was informed of this problem and cleanup operations were underway.

9. Sources of inflow should be eliminated. The cross connection at the intersection of Joseph Street and Lister Avenue should be sealed. The railroad siding drain on the south side of the Messinger Warehouse should be disconnected from the sanitary sewer. The Atlas roof and area drains have already been discussed.

10. The Lister Avenue storm sewer, west of Lockwood Street should be cleaned of debris, sediment and oily wastes.

VI. Brown Street

A. Configuration

The 24-inch Brown Street storm sewer and the adjacent 15-inch sanitary sewer are located in the former Brown Street right of way. When the street was vacated, the City retained ownership of the storm sewer and the PVSC retained ownership of the sanitary sewer. Before the area sewers were separated, the Brown Street line was used as a wet weather outfall. There is an existing regulator at the southerly end of the storm sewer and cross-connections to the adjacent sanitary sewer are shown on various plans. The regulator and the cross-connections were sealed during the sewer separation program. The present sewer easement passes through the Sherwin Williams plant site. An industrial building has been constructed over the northern end of the storm sewer. Two piles were driven through the storm sewer during the construction of this building. A chamber was built at that point to allow flow to pass around the piles. Several storm drains at the plant complex have been connected to the 24-inch sewer.

B. Physical Inspection Findings

No point sources of pollution were found during the physical inspection. The bulkhead in the Brown Street regulator is not leaking and the cross-connections to the sanitary sewer are sealed. No evidence of chemical spillage was observed in chemical storage areas, parking lots, access roads, or loading dock areas tributary to the storm sewer. The storm sewer is below high tide elevation and approximately 15,000 gallons of river water are carried in and out of the pipe during each tidal cycle. No flow was observed upstream of the building during low tide. A discharge of approximately 25,000 gpd was noted at the bulkhead downstream of the building. This flow rate was visually estimated because there was no direct access to the point of discharge. Personnel from the City of Newark and the PVSC have observed flow during the low tide. The source of this flow may be infiltration or a connection from the Sherwin Williams plant.

The PVSC inspected the storm and sanitary sewers in 1970. The sanitary sewer was televised and dye tests were performed. This investigation was conducted to determine the sources of oil and other pollutants entering the sanitary sewer and storm drainage systems. Chemicals and oil were found seeping into the sanitary manholes. Several leaks were observed when the sanitary sewer was televised. The internal inspection of the storm sewer was not successful. An attempt was made to plug the pipe to keep tidal flow out. Infiltration was so severe that the line quickly filled up as the tide rose. Debris prevented inspection of the southerly end of the line. The piles made inspection of the pipe under the building impossible. Repairs were made to the sanitary sewer; the seepage of brown oil was eliminated and infiltration was reduced. The sanitary sewer was dye tested and no dye was detected in the storm sewer. The Sherwin William plant engineer cooperated fully during this investigation. The plant piping was evaluated and no sources of pollutants were found within the building. The plant engineer also verified that the site had been used for chemical dumping in the past. Lagoon-like pools, called stillbottoms, were formed with earth berms and filled with the liquid wastes from chemical processes. After the wastes seeped into the ground, the berms were leveled off on top of the residue. The existing plant buildings, chemical storage areas, and parking lots are constructed on top of the contaminated ground. A steel bulkhead prevents this material from seeping directly into the river. The PVSC concluded that contaminated groundwater was the source of the dry weather pollutants in the Brown Street Storm sewer.

C. Dry Weather Effluent Sampling

The PVSC obtains monthly samples at the storm sewer outfall. These samples do not show a continuously contaminated effluent. Acceptable samples have been obtained for periods as long as six months. The most polluted sample in the last two years had a COD of 350 ppm $\pm$. Samples obtained upstream of the building contain lower levels of pollutants than those taken at the outfall. This could indicate infiltration of polluted groundwater under the building or an intermittent discharge from a source within the structure. An analysis performed during the PVSC inspection in 1970 revealed petroleum based oil, esthers, and keytones in the groundwater seepage. The PVSC laboratory has determined that the pollutants found in the Brown Street effluent are not similar to the chemicals presently being used at the Sherwin William plant. Groundwater pollution was beyond the scope of this study so no further investigative work was performed. However, the available data strongly suggests contaminated groundwater as the source of pollutants. The degree of contamination depends on groundwater levels, river stage, and tidal levels.

D. Conclusions and Recommendations

1. The source of pollutants in the dry weather storm sewer effluent appears to be infiltration of contaminated groundwater. Further investigations of this source were not made because groundwater pollution was excluded from the scope of this study. Rehabilitating the existing storm sewer would be expensive. The building constructed over the sewer would make reconstruction impractical in its present location. Piling driven through the existing sewer would prevent conventional grouting or relining under the building. A practical alternative might be to abandon, sand fill and plug the existing sewer. Responsibility for a replacement sewer to provide drainage for the Sherwin Williams Co. plant complex is a matter of negotiation. However, this work may not result in benefit to water quality since pollutants could still leach to the river.

2. The City of Newark should formally request Sherwin Williams to certify that there are no connections to the storm sewer beneath its factory building. Sherwin Williams should receive copies of all sampling results concerning the Brown Street storm sewer.

VII. General Recommendations

A. Groundwater pollution in the study area should be investigated. Contaminated groundwater is believed to be a source of pollutants in the Brown Street and Blanchard Street storm sewers and the Roanoke Avenue outfall sewer. Chemical plants have been located in the area for several decades. Septic systems were used to dispose of wastes prior to the construction of sanitary sewers. Wastes were dumped and allowed to seep into the ground in the Brown Street area. Chemical spillage was noted at several plants during this study. Groundwater pollution was outside our scope of work and was not investigated in greater detail. Leaching groundwater from this area may significantly impact on the water quality of the Passaic River after other corrective measures have been completed.

B. Industrial facilities and railroad spurs should be inspected frequently to evaluate housekeeping procedures and identify spillage. Immediate action should be taken to have industries clean up spillage for which they are responsible.

C. An effective sewer use Ordinance should be enforced to protect the City's investment in its sewer system and the PVSC facility and to provide for a cleaner environment.

D. A regular maintenance program should be developed for tide gates, regulators, and storm drainage systems. Inlets should be cleaned of sediment and debris.

E. Hazardous conditions exist in the sewers discussed herein. Oxygen deficiencies and explosive atmospheres may exist intermittently although none were detected during this study. An explosion has occurred in the Roanoke Avenue combined sewer. Sewers should be force ventilated during all inspection, cleaning and maintenance operations. Oxygen content and explosive potential should be monitored continuously while personnel are working below ground. The atmosphere may be harmful to breathe even if it is not oxygen deficient or explosive. The effluent and sediment may also be hazardous. Chemicals used at some plants may attack the skin on contact and others may be absorbed and cause internal damage. All personnel working in the sewer should be equipped with breathing apparatus, protective clothing, explosion-proof lights, and safety lines. Additional personnel and equipment should be available to react to emergencies.

APPENDIX A

Analytical Test
Results

TABLE 1

ANALYSIS OF STORM SEWER FLOW SAMPLES
(POLLUTANT CONCENTRATIONS IN PPM)

SAMPLING POINT	pH	COD	TOC	BOD	Cl	TURB	TSS	F.C. /100Ml	PO4	FLAM	EXPLO	TKN	NH4-N
B-2	7.5	148	40	36	447	68	30	-	.09	0	0	24	21
B-6	7.7	228	66	46	286	100	102	-	.12	0	0	47	34
LW-0	7.4	216	165	141	340	100	65	-	.13	0	0	101	93
LW-1	8.4	2456	920	819	232	2700	2404	-	.06	0	0	100	67
LS-2	9.0	3176	1040	696	118	4000	2516	-	.19	0	0	93	63
LS-4	8.8	336	115	133	718	320	67	-	.06	0	0	70	66
A-1	8.7	1000	240	387	110	3200	2876	1800	.19	0	0	40	10
E-1	8.7	24	8	0	180	25	18	1000	.04	0	0	2	0
MC-1	7.6	960	60	36	143	89	423	200	.30	0	0	63	61
MC-100	7.3	232	52	51	23	73	56	38000	1.80	0	0	2	0
MC-7	6.8	460	135	138	255	320	89	100	.40	0	0	9	3

SAMPLES TAKEN ON MAY 2, 1978

TABLE 2

ANALYSIS OF STORM SEWER FLOW SAMPLES
(POLLUTANT CONCENTRATIONS IN PPM)

SAMPLING POINT	pH	COD	TOC	BOD	Cl	TURB	TSS	F.C. /100 Ml	TKN	NH4-N	Grease & Oil
B-2	7.2	412	170	450	307	178	63	1200	19	16	41.6
B-6	7.6	135	56	126	360	344	334	0	20.3	17.1	-
B-7	7.5	150	62	114	331	136	51	200	17	16	0
LS-2	7.2	1119	520	486	335	168	153	0	106	59.4	300.4
LS-4	7.9	408	180	210	517	308	156	0	38	31.5	36.2
LS-7	7.2	1188	520	443	124	3080	2180	500	23.5	7.56	-
LW-1	8.7	6386	560	690	250	344	684	0	217	164	25.6
LW-4	8.2	824	320	455	644	308	204	0	97	71	22.6
LW-7	5.4	5496	1520	1550	1650	142	323	29000	393	184	66.6
A-1	6.9	313	93	169	859	86	152	6800	27	18	-
A-3	7.3	83	19	35	24	45	196	67000	6	.7	14.2
E-1	7.3	44	10	0	13	30	20	0	1.7	0	8.0
E-104	8.6	36	7	0	14	30	1	100	2	.98	.8
MC-1	7.1	48	13	0	141	27	40	1700	.8	.6	4.6
MC-3	6.9	44	14	0	143	18	30	900	0	0	-
MC-7	5.9	622	195	350	14	200	-	250,000	1.96	1.8	-
MC-100	6.7	954	270	480	24	93	103	4700	2.7	0	-
MC-104	7.4	337	96	156	19	86	85	27,000	1.7	0	-

SAMPLES TAKEN ON June 14, 1978

TABLE 3

ANALYSIS OF METAL CONCENTRATIONS IN STORM SEWER FLOW SAMPLES
(METAL CONCENTRATIONS IN PPM)

SAMPLING POINT	Cd	Ca	Cr	Cu	Fe	Pb	Mg	Mn	Ni	Na	Zn
B-2	-	0	-	-	5.6	-	-	-	-	0	-
B-6	-	0	-	-	28.9	-	-	-	-	0	-
B-7	-	0	-	-	5.39	-	-	-	-	0	-
LS-2	.03	-	.01	2.4	2.4	.1	21	3.4	.1	-	6
LS-4	.02	0	.03	-	6.04	.1	21	1.9	.1	-	8
LW-1	.07	-	.10	-	7.46	2.1	25	3.1	.1	-	26
LW-7	.20	-	.11	-	4.58	1.9	21	2.6	.1	-	12
A-1	-	-	-	-	5.88	.1	-	-	-	-	-
MC-1	-	-	-	-	0	0	-	-	-	-	0

SAMPLES TAKEN ON JUNE 14, 1978

APPENDIX B

Letter From
Robinson Pipe Cleaning Company

Robinson Pipe Cleaning Co.

Specializing in today's needs for environmental protection.
875 North Summer Avenue • Newark, NJ 07104 • (201) 483-3200

August 22, 1978

Clinton Bogert Associates
2125 Center Avenue
Fort Lee, New Jersey 07024

Attention: Herbert L. Kaufman

SUBJECT: Television Inspection, City of Newark

Gentlemen:

With reference to the above named project, the following is a detailed description of the problems we encountered on Blanchard Street, between manholes B1 and B7, and Lister Street, between manholes LS11 and LS4.

Blanchard Street, manholes B7 to B5

We began cleaning on Blanchard Street between manholes B7 and B5 on July 11, 1978. A 15 inch bucket was dragged between the manholes with relative ease. On the first drag with an 18 inch bucket, the bucket hung approximately 30 feet from manhole B5.

July 12, 13, 1978, were spent retrieving the 18 inch bucket and using various size slitters to break any hard material that would prohibit the passage of buckets.

July 14 through July 18, 1978, various size slitters and 12 inch and 15 inch buckets were used to remove sand, silt, a hard yellowish material, and concrete. Because the tidal gate was malfunctioning, sand and silt continued to wash into the line.

On July 18, 1978, we removed segments of pipe and therefore discontinued further cleaning.

Blanchard Street, manholes B5 to B3

On July 19, 1978, we dragged 12 inch and 15 inch buckets between manholes B5 and B3 with great difficulty. Because the buckets continued to hang in the pipe line, various size slitters were used.

ROBINSON PIPE CLEANING COMPANY

On July 20, 1978, an 18 inch bucket was hung between manholes B4 and B3. Between July 21 and July 28, 1978, 12 inch and 15 inch buckets and slitters were used to remove sand, silt, a yellowish material and concrete.

On July 28, 1978, we removed segments of pipe and discontinued further cleaning.

Blanchard Street, manholes B3 to Bl

Between July 31 and August 4, 1978, we dragged various size slitters, 12 inch and 15 inch buckets between manholes B3 and Bl. We were only able to drag to approximately 15 feet from manhole Bl. The same problems were encountered and the same materials were removed that were found between manholes B7 and B3.

On August 4, 1978, we removed segments of pipe and discontinued further cleaning.

Blanchard Street, Television Inspection

Manholes: B7-B6, camera submerged, unable to pass or distinguish blockage.
B6-B5, camera submerged, unable to pass or distinguish blockage.
B5-B4, the pipe dropped approximately 5 feet from manhole 5 and the line was surcharged. No attempt was made to televise.
B4-B2, unable to thread these two sections with the use of high pressure water or power rodding equipment.
B2-Bl, structural defects, unable to pass.

Because of the condition of the pipe between manholes B7 and Bl, we find that television inspection is impossible.

It is our opinion that the pipe is badly deteriorated and structurally unsound. Further work might result in a complete failure.

Lister Street, manholes, LS11 to SL4

The major problem on Lister Street between manholes LS11 and LS4 were sags that developed pockets of water and grit. Because the camera lens was submerged passing through the sags, portions of the pipe line were not able to be seen.

We trust that this meets with your approval.

Sincerely,
ROBINSON PIPE CLEANING COMPANY

Salvatore F. Perri
Sales Representative

SFP:med

Robinson Pipe Cleaning Co.

Specializing in today's needs for environmental protection.

875 North Summer Avenue • Newark, NJ 07104 • (201) 483-3200

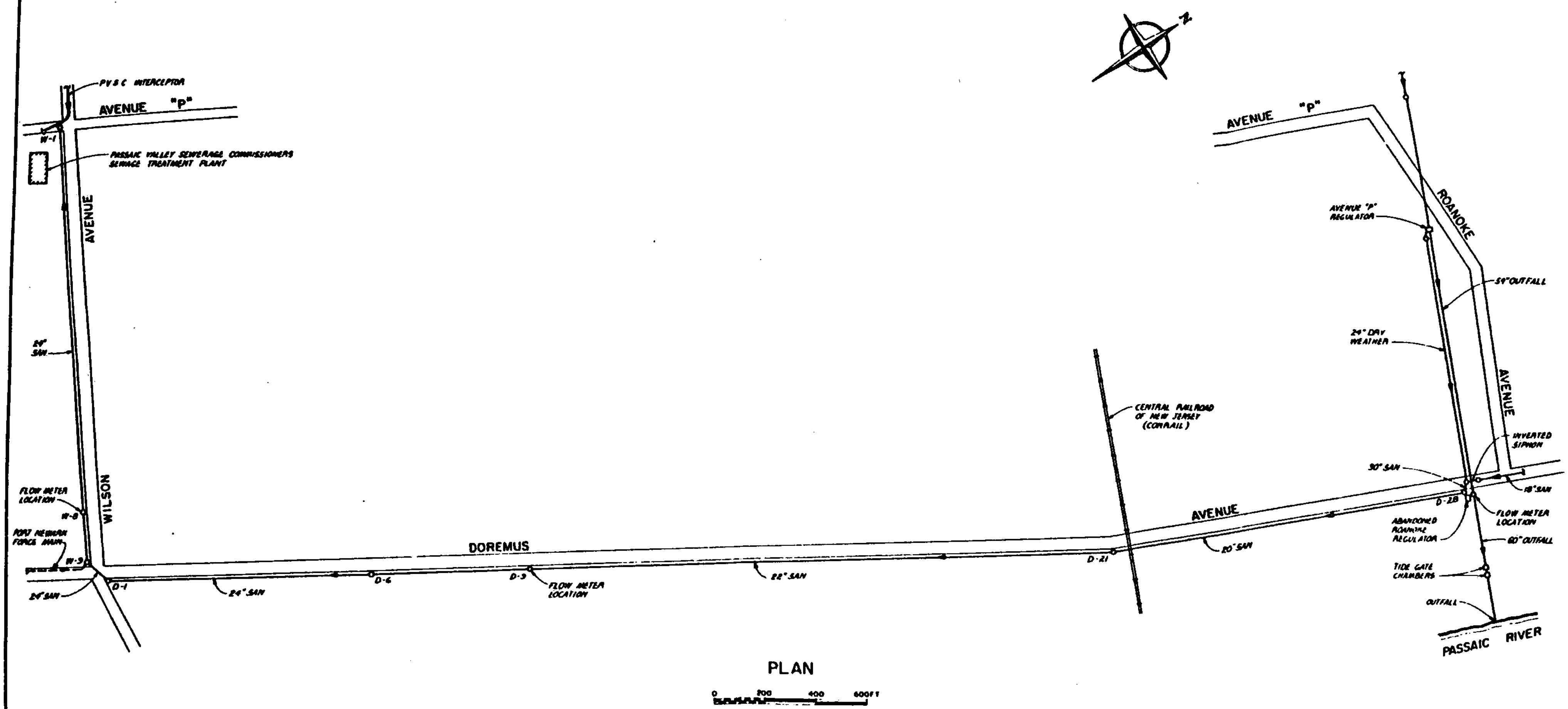
August 22, 1978

Clinton Bogert Associates
2125 Center Avenue
Fort Lee, New Jersey 07024

Services rendered for cleaning and television inspection in the City of Newark, New Jersey, as follows:

ALBERT AVENUE		
A3-A2	243'	
A2-A1	196'	
	439' @ Lump sum	$ 600.00
BLANCHARD STREET		
B1-B7	1245' @ $6.00	7470.00
LISTER STREET		
LS11-LS7	545'	
LS7-LS4	468'	
	1013' @ $1.50	1519.50
LS3-LS1	333' @ Lump sum	600.00
LOCKWOOD STREET		
8-7	245'	
7-5	132'	
5-4	306'	
4-1	721'	
	1404' @ $1.50	2106.00
MORRIS CANAL		
MC104-MC102	365'	
MC102-MC100	394'	
	759' @ $1.50	1138.50
		$13434.00

ILLUSTRATIONS

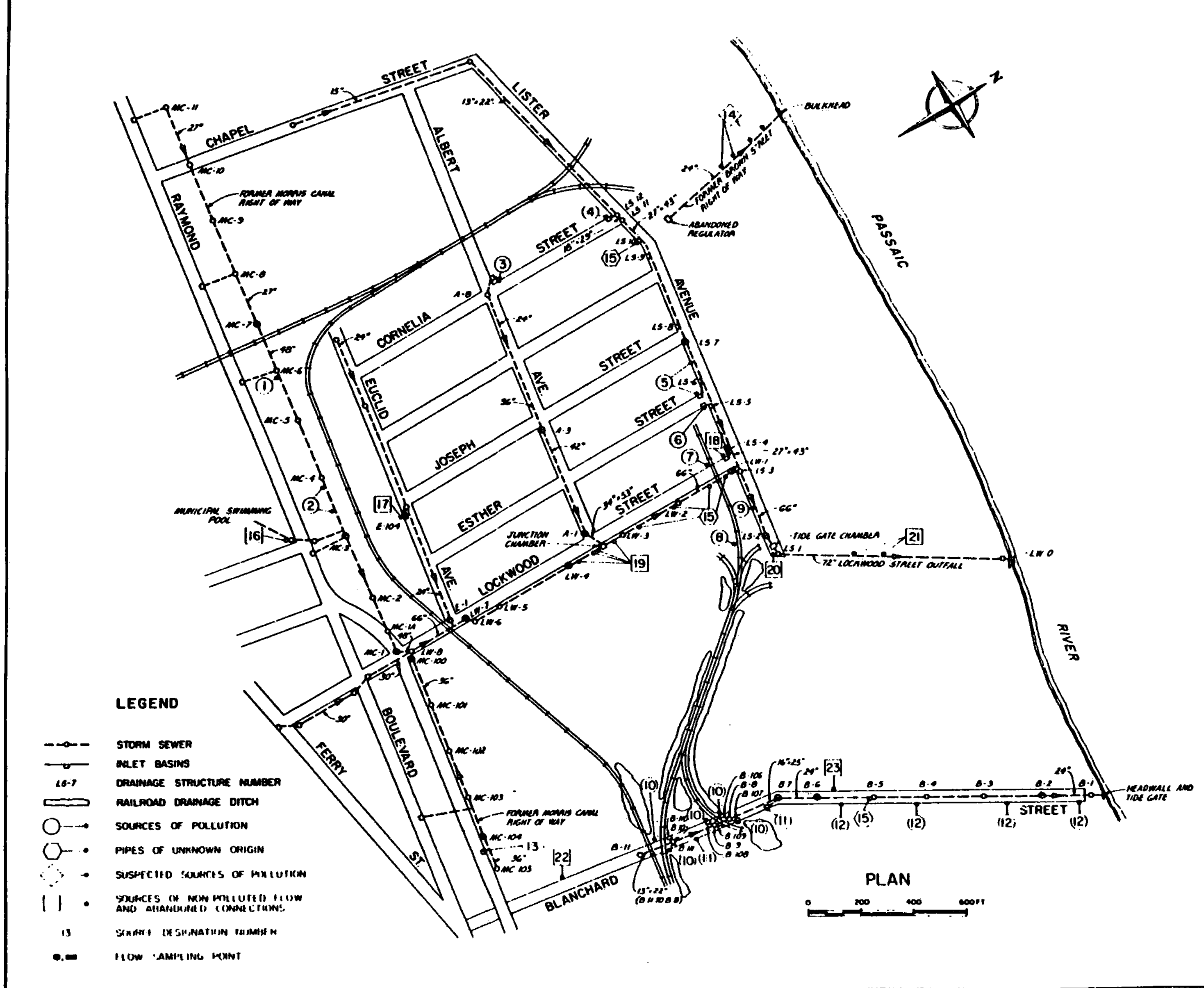


NEWARK POLLUTION ABATEMENT FEASIBILITY STUDY

SANITARY AND COMBINED SEWER CONFIGURATIONS ON ROANOKE, DOREMUS AND WILSON AVENUES

CLINTON BOGERT ASSOCIATES
CONSULTING ENGINEERS

PLATE I



DESIGNATION NUMBER	SOURCE DESCRIPTION
1	INTERMITTENT DUMPING OF PAINT INTO INLET AT ASSOCIATED AUTO BODY AND TRUCKS INC.
2	CAR WASH DRAINS AT SUNOCO STATION CONNECTED TO STORM SEWER.
3	INTERMITTENT, LOW VOLUME DISCHARGE OF OIL AND WATER ENTERING INLET FROM CELLOMER CORP.
4	CONTINUOUS FLOW OF ORANGE VISCOUS CHEMICALS ENTERING INLET FROM CELLOMER CORP.
5	CONTINUOUS FLOW OF BLACK OILY CHEMICALS ENTERING INLETS FROM B-LINE TRUCKING COMPANY.
6	INTERMITTENT, LOW VOLUME DISCHARGE OF OIL AND WATER ENTERING INLET FROM FISKE BROTHERS REFINING COMPANY.
7	INTERMITTENT DISCHARGE OF BLACK OILY CHEMICALS ENTERING INLET FROM FISKE BROTHER REFINING COMPANY RAILROAD SIDING.
8	CHEMICAL SPILLAGE AT ATLAS REFINERY INC. RAILROAD SIDING CONTAMINATING GROUND AND ENTERING RAILROAD DRAINAGE DITCHES DURING WET WEATHER.
9	RAILROAD DRAINS AND OIL SEPARATOR AT ATLAS REFINERY INC. CONNECTED TO STORM SEWER.
10	INTERMITTENT FLOW OF WATER AND CHEMICALS ENTERING INLETS FROM RAILROAD DRAINAGE DITCHES.
11	FREQUENT OVERFLOW OF SEWAGE FROM SANITARY MANHOLES ENTERING INLETS.
12	OCCASIONAL OVERFLOW OF SEWAGE FROM SANITARY MANHOLES ENTERING INLETS.
13	CONTINUOUS DISCHARGE FROM NEWARK BOXBOARD COMPANY.
14	INLETS AND DRAINS AT SHERWIN WILLIAMS COMPANY CONNECTED TO STORM SEWER.
15	PIPES OF UNKNOWN ORIGIN.
16	CONTINUOUS FLOW FROM MUNICIPAL SWIMMING POOL (SEASONAL).
17	CONTINUOUS FLOW OF COOLING WATER ENTERING INLET FROM REDDAWAY MANUFACTURING COMPANY.
18	INTERMITTENT DISCHARGE OF COOLING WATER ENTERING INLET FROM FISKE BROTHERS REFINING COMPANY.
19	ROOF DRAIN CONNECTIONS FROM THE MESSINGER WAREHOUSE AND TRUCKING COMPANY AND ABANDONED INLET CONNECTION.
20	ABANDONED RAILROAD DRAIN CONNECTED TO MANHOLE LS-1
21	ROOF DRAIN CONNECTIONS FROM THE BENJAMIN MOORE COMPANY.
22	CONTINUOUS, LOW VOLUME DISCHARGE OF COOLING WATER ENTERING GUTTER FROM NEWARK BOXBOARD COMPANY.
23	INTERMITTENT DISCHARGE OF GROUNDWATER ENTERING GUTTER FROM SUMP PUMP AT FAIRMOUNT CHEMICAL COMPANY.

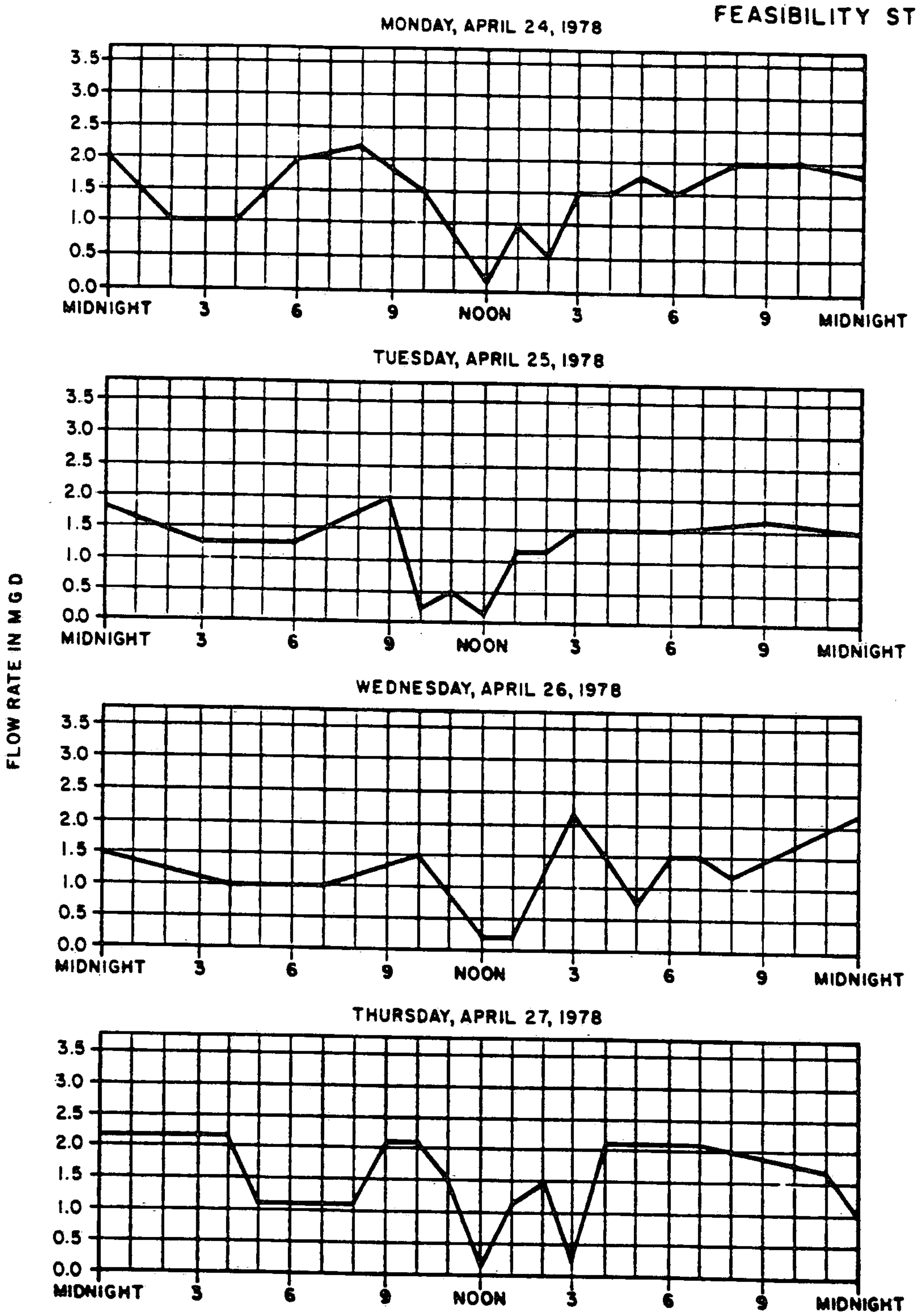
NEWARK POLLUTION ABATEMENT FEASIBILITY STUDY

SOURCES OF POLLUTION IN STORM SEWER SYSTEMS ON BLANCHARD, LOCKWOOD AND BROWN STREETS

CLINTON BOGERT ASSOCIATES
CONSULTING ENGINEERS

PLATE 2

CITY OF NEWARK
POLLUTION ABATEMENT
FEASIBILITY STUDY



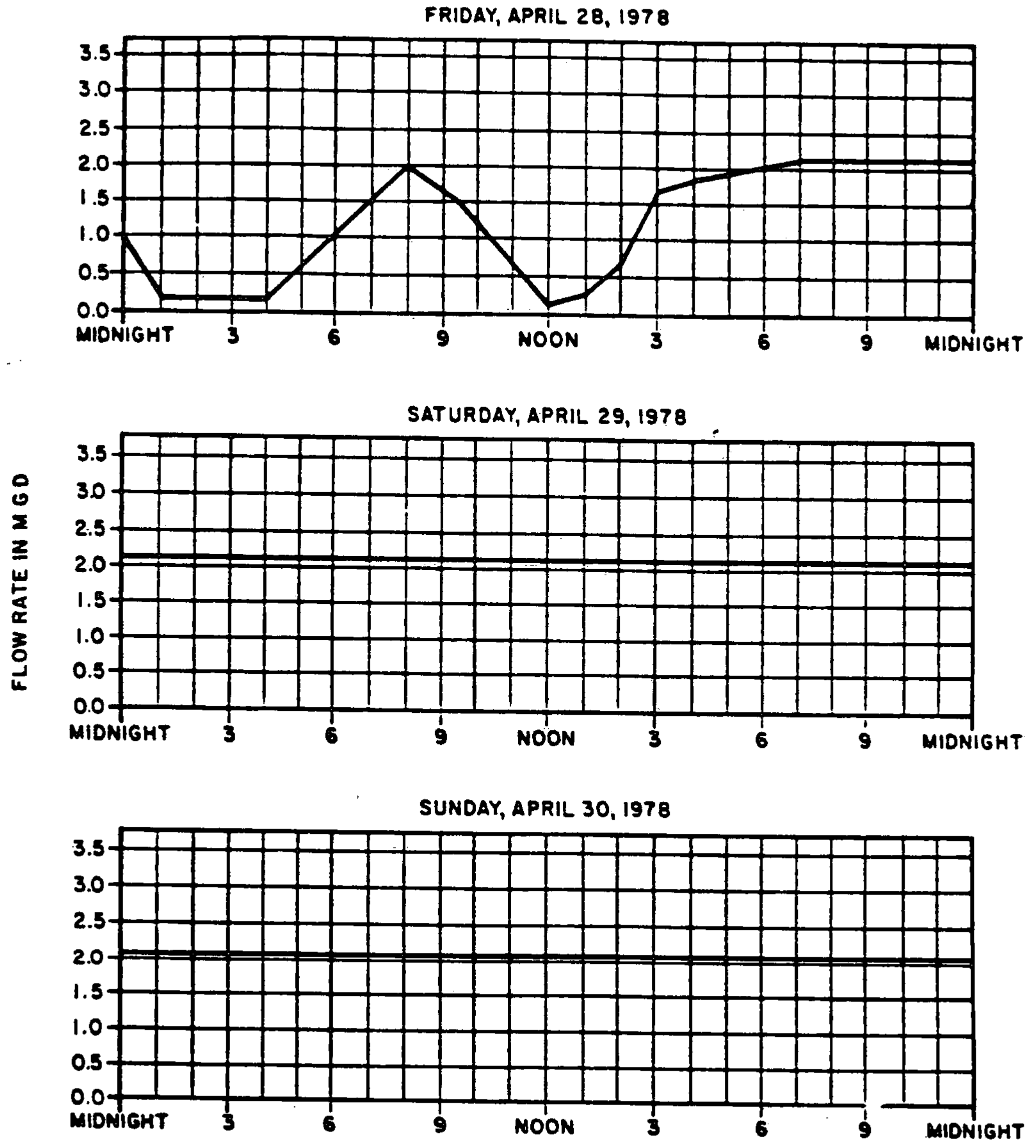
DIURNAL SEWAGE FLOW PATTERNS

ROANOKE AVENUE OUTFALL SEWER

DIETZGEN 5484

CLINTON BOGERT ASSOCIATES

PLATE 3

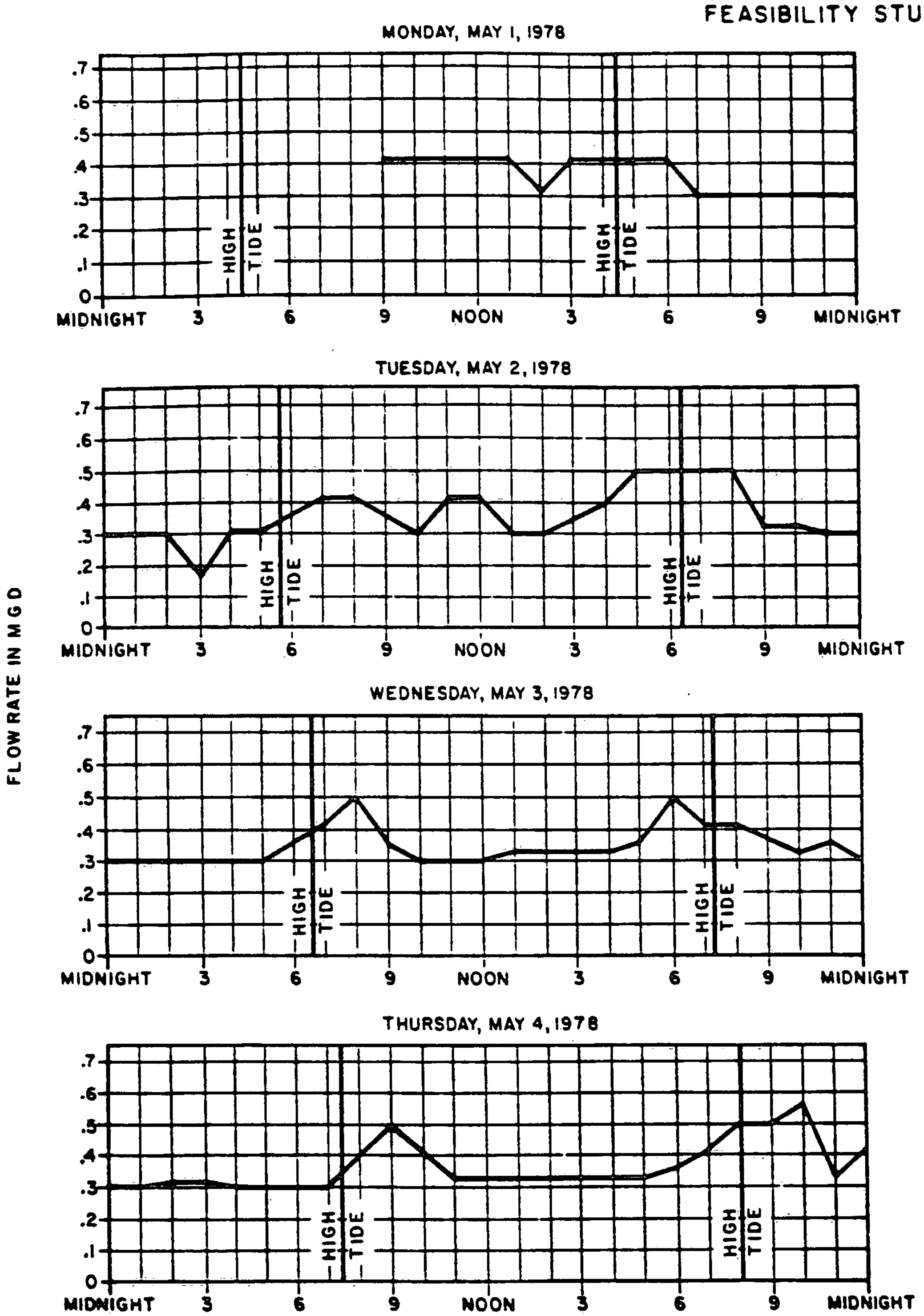


DIURNAL SEWAGE FLOW PATTERNS

ROANOKE AVENUE OUTFALL SEWER

CITY OF NEWARK

POLLUTION ABATEMENT FEASIBILITY STUDY



DIURNAL SEWAGE FLOW PATTERNS

DOREMUS AVENUE INTERCEPTOR

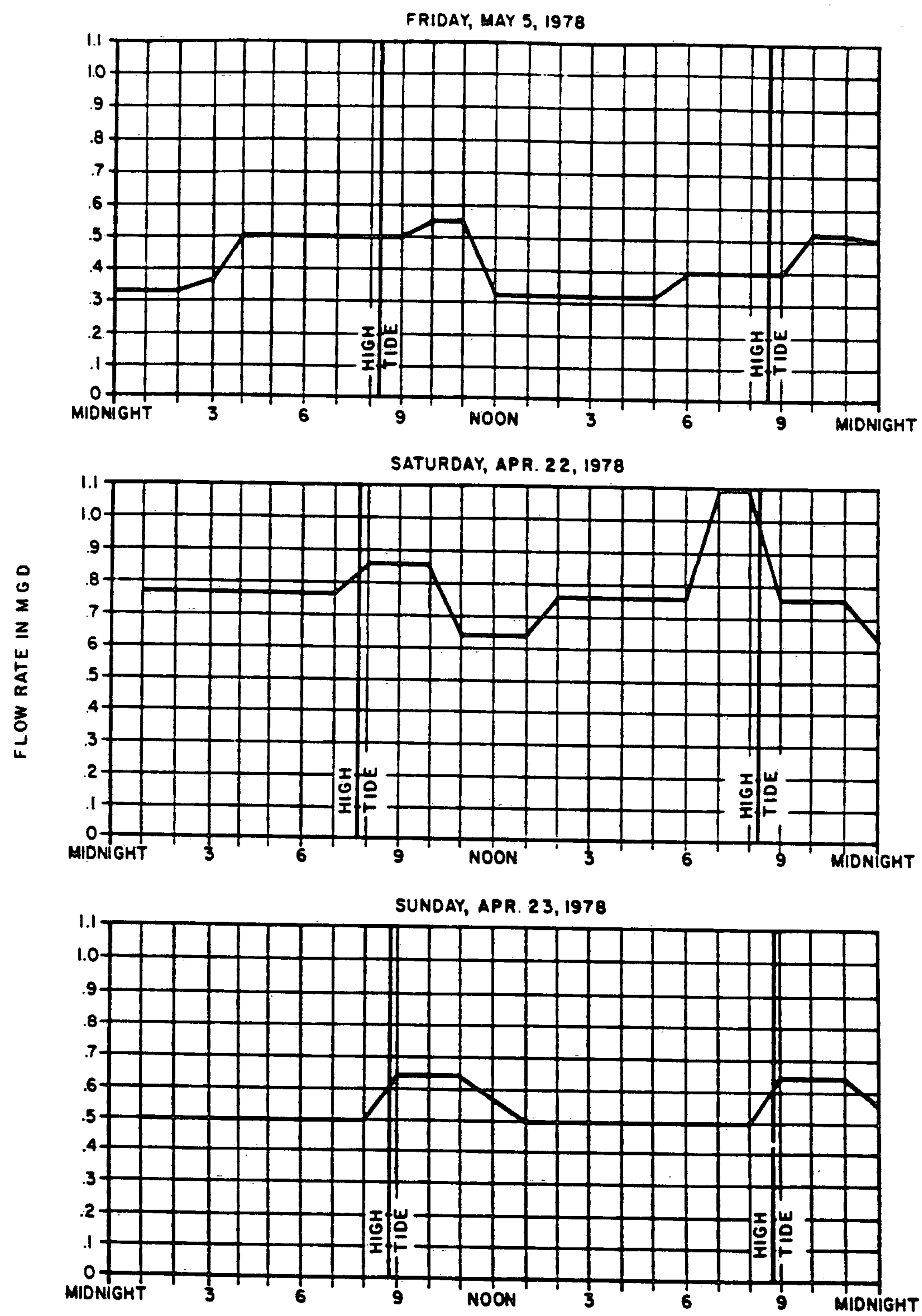
DIETZGEN 54841

CLINTON BOGERT ASSOCIATES

PLATE 5

CITY OF NEWARK

POLLUTION ABATEMENT
FEASIBILITY STUDY



NOTES:
1- FLOW METER MALFUNCTIONED ON 5/6
2- SPRING HIGH TIDE AT 8:15 P M ON 4/22

DIURNAL SEWAGE FLOW PATTERNS

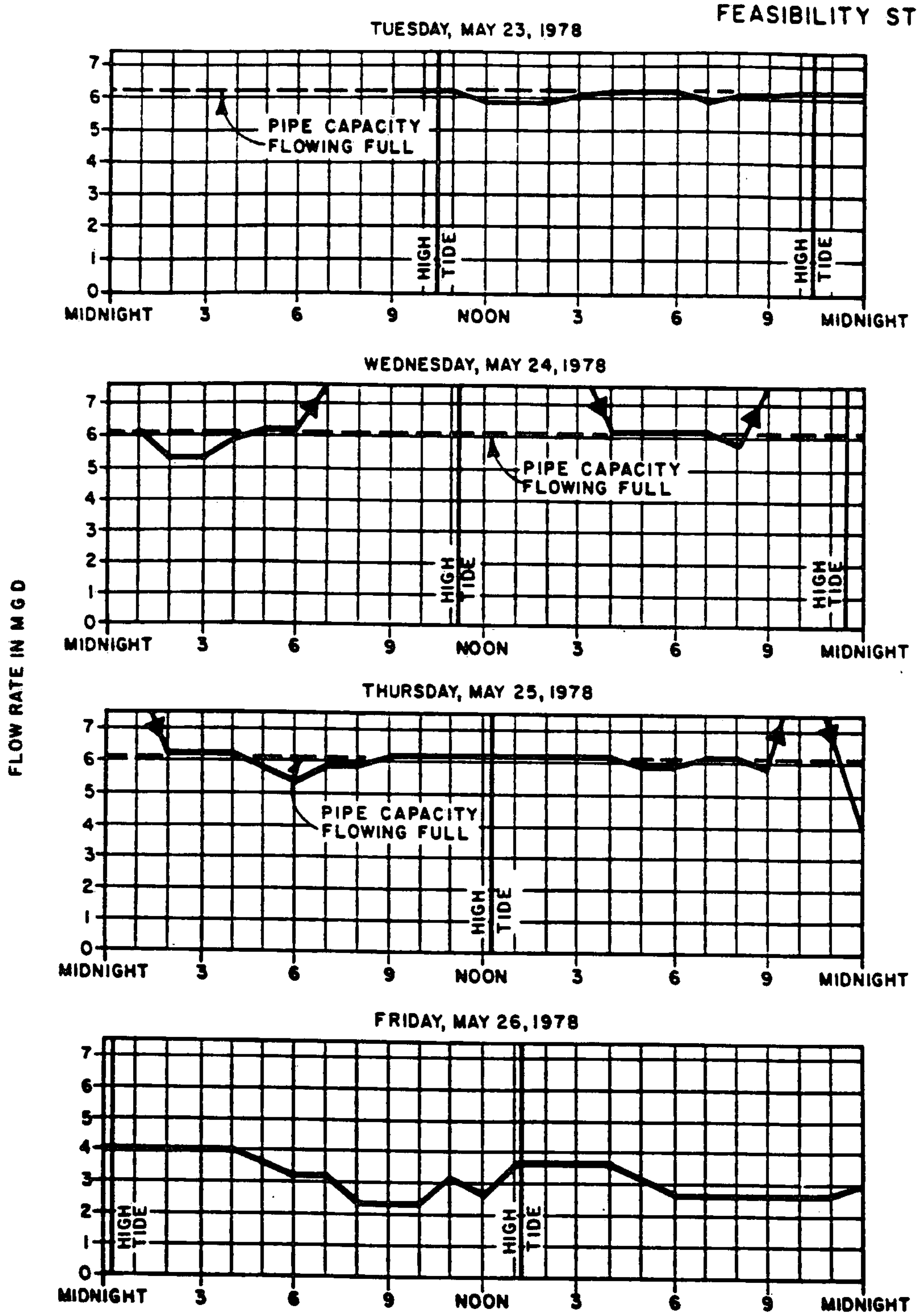
DOREMUS AVENUE INTERCEPTOR

DIETZGEN 3484I

CLINTON BOGERT ASSOCIATES

CITY OF NEWARK

POLLUTION ABATEMENT FEASIBILITY STUDY



NOTES:

1- RAINFALL OF 2.75" ON 5/24 AND 5/25

2- FLOW RATES ABOVE 6.2 M G D INDICATE SURCHARGED PIPE

DIURNAL SEWAGE FLOW PATTERNS

WILSON AVENUE INTERCEPTOR

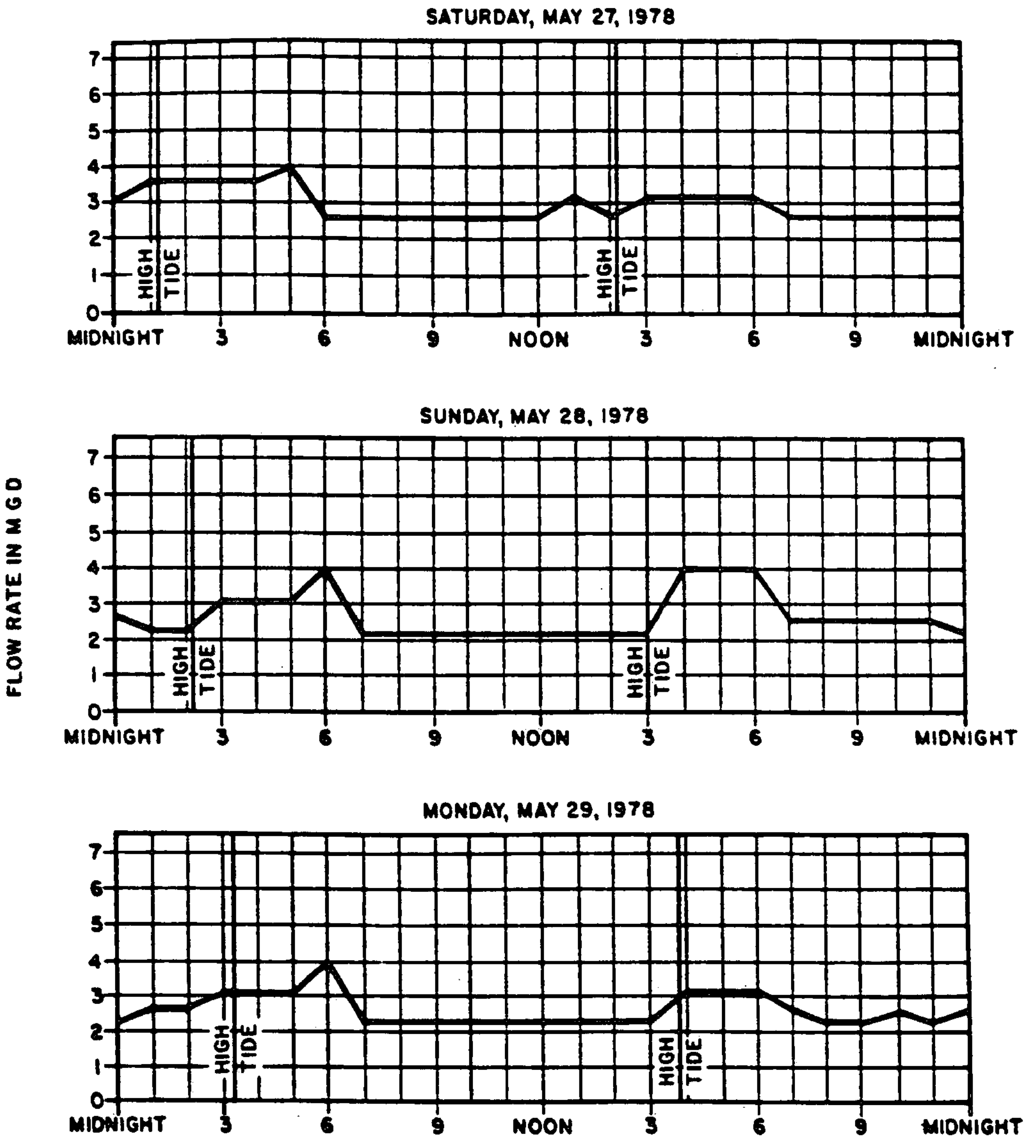
DIETZGEN 341

CLINTON BOGERT ASSOCIATES

PLATE 7

CITY OF NEWARK

POLLUTION ABATEMENT
FEASIBILITY STUDY



DIURNAL SEWAGE FLOW PATTERNS

WILSON AVENUE INTERCEPTOR

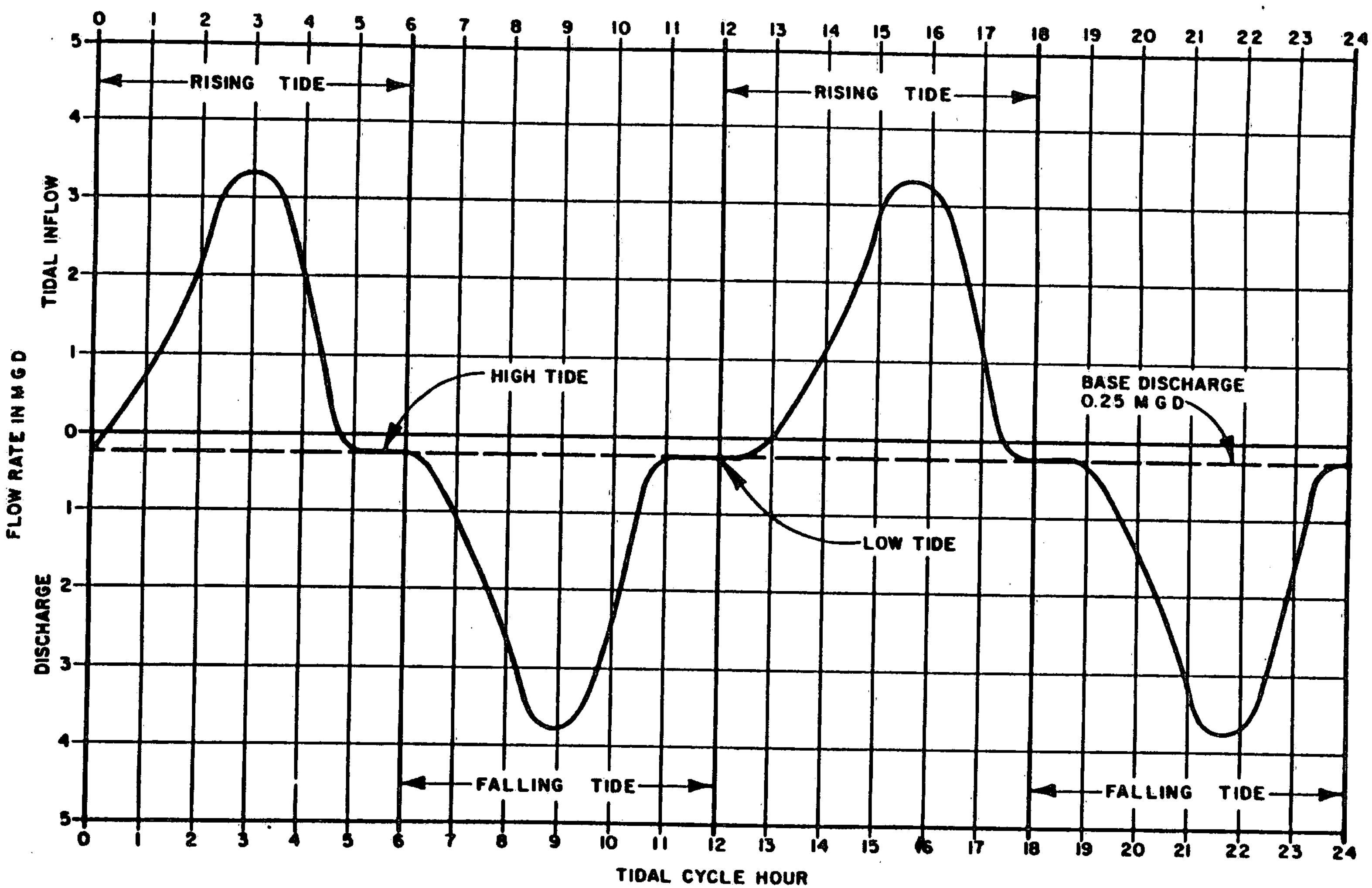
DIETZGEN 34641

CLINTON BOGERT ASSOCIATES

PLATE 8

DIETZGEN 54841

CLINTON BOGERT ASSOCIATES



FLOW RATES AT THE
LISTER AVENUE TIDE GATE CHAMBER

CITY OF NEWARK
POLLUTION ABATEMENT
FEASIBILITY STUDY

PLATE 9